radionuclide analyses for the samples taken from the 116-H-2 borehole are presented in Table A-7, Appendix A.

3.3.2.3 Field Screening. During continuous field screening of the 116-H-2 borehole, no VOC concentrations above the action level (10 ppm above background) were detected, nor was radionuclide activity above the background level of 50 CPM detected.

3.3.2.4 Geophysical Borehole Logging. Logging with a spectral gamma-ray system was performed on the 116-H-2 borehole. No man-made radionuclides (Co-60, Cs-137, Eu-152, and Eu-154) were detected in the borehole.

3.3.3 Conclusions

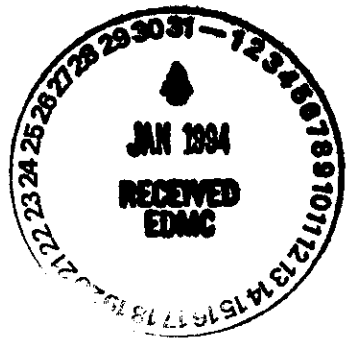
The 116-H-2 effluent disposal trench does not contain any inorganic contaminants above the 95 percent UTL, nor organic or pesticide contaminants. Small amounts of radionuclides (naturally occurring isotopes) were detected. However, Dorian and Richards (1978) reported radionuclide contamination (including H-3, Co-60, Sr-90, Cs-137, Eu-152, Eu-154, Eu-155) of up to 77 pCi/g at depths of 1 to 10 ft (0.3 to 3.0 m) bgs at this site. This historical data is inconsistent with the LFI data reported here. Figure 3-2 presents a comparison of the various types of LFI data that were collected for the 116-H-2 disposal trench.

The vadose zone borehole was drilled in the southwest corner of the 116-H-2 site. This location was chosen based on discussions at meetings with regulators that considered lateral extent of the site, access, etc. It is possible that a second borehole, located near the center of the trench, would detect contamination at similar levels to that detected by Dorian and Richards (1978).

Sample analysis does not indicate the presence of sodium dichromate in the soil column. The contaminant may have been flushed through the soil to the groundwater. Or, as discussed above, the lack of detection may be associated with the borehole location.

There are no directly analogous sites to the 116-H-2 effluent disposal trench.

No specific conclusions can be drawn concerning the level of contamination at this site due to the inconsistency between the results of the field data and the historical data. The historical data was used in the development of the QRA to be conservative. The inconsistencies between the field and historical data do not assist in generating an accurate conceptual model of the site.



3.3.4 Groundwater Assessment

Results from sampling at monitoring well H4-46, located down gradient from the 116-H-2 site, did not indicate any Sr-90, Tc-99, or gross alpha contamination. The 116-H-2 site does not appear to be having an impact on the groundwater.

3.4 116-H-3 DUMMY DECONTAMINATION FRENCH DRAIN

The 116-H-3 dummy decontamination French drain is a vertical leaching drain located within the H Reactor building security fence, directly east of the reactor building (Figure 2-1). The drain is 3 ft (0.9 m) in diameter, approximately 15 ft (4.6 m) deep and is made of vitreous tile conduit. From 1950 to 1965, wastes generated during decontamination of fuel-element spacers were transferred to this drain for disposal. Approximately 4,400 lb (2,000 kg) each of sodium dichromate, sodium oxalate, and sodium sulfamate were disposed of in the 116-H-3 drain (WHC 1993a). The drain is presently covered to grade with soil.

3.4.1 Geology

This site is characterized by sandy gravel fill to a depth of approximately 21.7 ft (6.6 m) bgs, the total depth of the borehole. A minor change in soil color occurs between 6 and 10 ft (1.8 and 3.0 m) bgs, but there is not enough change in other soil properties to determine if there is a fill/native soil contact represented here (Figure 3-3). All the material encountered in the borehole may be fill material.

3.4.2 Soil Samples

3.4.2.1 Chemical Analysis. The laboratory analysis of samples taken from the 116-H-3 vadose zone borehole (located near the southeast corner of the 116-H-3 site) showed no inorganic contaminant levels above the 95 percent UTL. There were no VOC, semivolatile organic, or pesticide contaminants detected. The complete results of the chemical analyses for the samples taken from the 116-H-3 borehole are presented in Table A-3, Appendix A.

3.4.2.2 Radionuclide Analysis. Seven radionuclides were detected in the soil samples from the 116-H-3 borehole (see Table 3-7). The radionuclides detected were Co-60, Eu-152, Ra-226, Th-228, Th-232, U-233/234, and U-238. All were detected at levels of < 1 pCi/g. The complete results of the radionuclide analyses for the samples taken from the 116-H-3 borehole are presented in Table A-8, Appendix A.

3.4.2.3 Field Screening. No levels of VOCs above the action level (10 ppm above background) were detected during continuous field screening of the 116-H-3 borehole. There also was no radionuclide activity detected above the background level of 75 CPM.

3.4.2.4 Geophysical Borehole Logging. Logging was performed on the 116-H-3 borehole using a spectral gamma-ray system. Small amounts of man-made radionuclides (Co-60,

Eu-152, and Eu-154) were detected in the borehole. Cobalt-60 was encountered in two intervals in the survey; from the surface to 1 ft (0.3 m) and from 12 ft (3.7 m) to the maximum survey depth of 18 ft (5.5 m) bgs. The activity detected was less than 1 pCi/g. Similarly, Eu-152 was detected at activity levels of less than 5 pCi/g in two intervals—from the surface to 1 ft (0.3 m) and from 11 to 18 ft (3.6 to 5.5 m) bgs. Europium-154 was detected between 12 and 16 ft (3.7 and 4.9 m) bgs. The detected activity was not continuous and was less than 1 pCi/g. Cesium-137 was not detected in the borehole.

3.4.3 Conclusions

There is no indication of inorganic or organic contamination at the 116-H-3 dummy decontamination French drain. There is, however, some indication of radionuclide contamination both near the surface and at depth at the site. One soil sample, the spectral gamma-ray borehole logging, and the historical data from Dorian and Richards (1978) indicate the presence of relatively small amounts of radionuclide contamination between approximately 12 and 18 ft (3.7 and 5.5 m) bgs. The gamma-ray logs indicate traces of radionuclide contamination (Co-60 and Eu-152) near the surface. Figure 3-3 presents a comparison of the various types of LFI data that were collected for the 116-H-3 drain and detections of contaminants from the historical data.

Sample analysis does not indicate the presence of the sodium dichromate in the soil column. The contaminant may have been flushed through the soil to the groundwater.

No sampling was performed at the analogous 116-B-4 dummy decontamination French drain site as part of an LFI making comparison of data at the two sites impossible.

3.4.4 Groundwater Assessment

Based on limited results from sampling at monitoring well H4-47, located down gradient from the 116-H-3 site, the site does not appear to be having an impact to the groundwater.

3.5 116-H-7 PROCESS EFFLUENT RETENTION BASIN

The 116-H-7 process effluent retention basin is located in the southeast corner of the 100-HR-1 Source Operable Unit and is now enclosed within a chain-link security fence (Figure 2-1). This double-celled basin received process effluent (primarily cooling water effluent) from the H Reactor. The basin was 600 ft (183 m) long, 273 ft (83.2 m) wide, and 20 ft (6 m) deep (extending approximately 14 ft above the ground surface) with a capacity of approximately 25,000,000 gal (95,000,000 liters [L]) (Stenner et al. 1988). It was designed to retain cooling water effluent to allow for radioactive decay and thermal cooling. The effluent was then discharged directly to the Columbia River. Decontamination wastes from the H Reactor building drains were also pumped to this basin by the 132-H-3 pumping station (DOE-RL 1992a).

Prior to changing to parallel operation of both basins in 1954, the reactor effluent was normally routed to just one of the two concrete-lined cells of the basin. In the event of a fuel-element cladding rupture, cooling water would come in direct contact with the fuel element. When this occurred, the water from the side of the basin that had received the contaminated effluent would be drained to the 116-H-1 trench (Section 3.2) for soil column disposal (Dorian and Richards 1978).

The basin was active from 1949 to 1965. Sludge and waste from this basin were removed in 1953 and again in 1965. The material removed in 1953 was placed in an adjacent trench (116-H-7 disposal trench). Some of the sludge removed in 1965 was placed in the 116-H-1 trench. The standing walls of the retention basin were demolished into the basin, and the basin has been backfilled with soil. The present depth to the bottom of the basin is approximately 6 ft.

3.5.1 Geology

This site is characterized by sandy gravel fill to a depth of 5.8 ft (1.8 m) bgs. From 5.8 to 8 ft (1.8 to 2.4 m) bgs, the concrete bottom of the retention basin is encountered. Approximately 6 ft (1.8 m) of sandy gravel fill is found under the concrete floor of the basin to a total depth of 13.8 ft (4.0 m). Sandy gravel, with intermittent silt layers, makes up the native soil found between 13.8 and 20.8 ft (4.2 and 6.3 m) bgs, the total depth of the borehole (Figure 3-4).

3.5.2 Soil Samples

3.5.2.1 Chemical Analysis. Laboratory analysis results of a soil sample taken near the surface (1.0 to 3.0 ft [0.3 to 0.9 m] bgs) indicated elevated levels (above the 95 percent UTL) of arsenic and lead. Table 3-8 shows the contamination levels that were found. Samples taken below 3.0 ft (0.9 m) did not contain elevated levels of inorganic analytes.

The only VOC contaminant found in the 116-H-7 vadose zone borehole was toluene (Table 3-9). Toluene is a typical laboratory contaminant and the detection is probably a false positive detection. No semivolatile organic or pesticide compounds were detected in the soil samples taken from the borehole. The complete results of the chemical analyses for the samples taken from the 116-H-7 borehole are presented in Table A-4, Appendix A.

3.5.2.2 Radionuclide Analysis. The results of the radionuclide analysis of soil samples taken from the 116-H-7 vadose zone borehole are presented in Table 3-10. Twelve radionuclides, consisting of Co-60, Sr-90, Cs-137, Eu-152, Eu-154, Ra-226, Th-228, Th-232, U-235, U-238, Pu-239/240, and Am-241 were detected. The majority of the radionuclide contaminants were detected within the 8.0 and 16.4 ft interval. The complete results of the radionuclide analyses for the samples taken from borehole 116-H-7 are presented in Table A-9, Appendix A.

3.5.2.3 Field Screening. Continuous OVM field screening of the 116-H-7 borehole for VOCs resulted in no readings above the action level of 10 ppm above background.

Radionuclide screening showed activities ranging from 200 to 1,100 CPM between the depths of 5.8 and 14.8 ft (1.8 and 4.5 m). The peak of 1,100 CPM occurred at a depth of 13.8 ft (4.0 m) bgs. The radionuclide activity screening data is displayed in Figure 3-4.

3.5.2.4 Geophysical Borehole Logging. A spectral gamma-ray log was not performed on the 116-H-7 borehole because the logging equipment could not be brought into the contaminated retention basin.

3.5.3 Conclusions

The 116-H-7 process effluent retention basin area contains radionuclide contamination at depth and small amounts of heavy metal contamination (arsenic and lead) near the surface. The radionuclide contamination, based on the LFI data, extends from approximately 5 to 17 ft (1.5 to 5.2 m) bgs. This is also supported by the historical data (Dorian and Richards 1978), which indicates that radionuclide contamination extended to over 20 ft (6.1 m) bgs. Figure 3-4 presents a comparison of the various types of LFI data that were collected for the 116-H-7 retention basin and detections of contaminants from the historical data.

The 116-H-7 retention basins were considered analogous to the 116-D-7, 116-DR-9, and 116-C-5 retention basin sites. The 116-D-7, 116-DR-9, and 116-C-5 sites were sampled during the 100-DR-1 and 100-BC-1 LFIs (DOE-RL 1993c and DOE-RL 1993e). To assess the concept that this site is analogous, a comparison of the radionuclide and chemical analytical results from the 100-DR-1 and 100-BC-1 LFI samples, and the 100-HR-1 data, was made. The radionuclide contaminants found beneath the 116-D-7 and 116-H-7 sites are similar; both sites contain Co-60, Sr-90, Cs-137, Eu-152, Eu-154, Ra-226, Th-228, Th-232, U-235, U-238, Pu-239/240, and Am-241 There are many radionuclide contaminants found in the 116-DR-9 site that are absent at 116-D-7 and 116-H-7. These are Be-7, Na-22, Mn-54, Co-58, Fe-59, Zn-65, Zr-99, Tc-99, Ru-103, Ru-106, Cs-134, Ba-140, Ce-141, and Ce-144. Comparisons of metallic contaminants in samples from the three sites revealed no similarities other than the presence of lead. The 116-D-7 site has a similar assemblage of organic contaminants to the 116-H-7 site. The 116-DR-9 site was the only site of the four that containe VOCs, semi-volatile compounds, and/or pesticides. Because the additional radionuclides at site 116-DR-9 have not been detected in 116-H-7 samples, the 116-D-7 and 116-C-5 sites are better analogous than the 116-DR-9 site for the 116-H-7 vadose zone radionuclide contamination. This is also the case for organic contaminants and pesticides. The sites are not truly analogous.

3.5.4 Groundwater Assessment

Monitoring well H4-11, constructed and sampled as part of the 100-HR-3 Groundwater Operable Unit LFI (DOE-RL 1993d), is located downgradient from the 116-H-7 retention basin and has elevated gross alpha levels (4.3 pCi/liter), as well as elevated levels of Tc-99 (36 pCi/liter), Sr-90 (26 pCi/liter), and chromium (90 μg/liter) relative to upgradient wells. Monitoring well H4-13, also located downgradient of the 116-H-7 retention basin and south of H4-11 has elevated levels of Sr-90 only (33 pCi/liter).

Monitoring well data indicate that there is a current impact to the groundwater though the 116-H-7 sludge burial trench and the process effluent pipelines may also be contributing contaminants.

3.6 116-H-9 REACTOR CONFINEMENT SEAL PIT DRAINAGE CRIB

The 116-H-9 reactor confinement seal pit drainage crib is approximately 10 by 10 by 10 ft deep (3 by 3 by 3 m) and is located to the west of the H Reactor building (Figure 2-1). From 1960 to 1965, the crib received drainage from the 132-H-2 reactor exhaust air filter building seal pits. The radioactive effluent that drained to this crib contained radionuclides with short half-lives, and the crib was released from radiological controls prior to 1967. The crib received approximately 79,500 gal (300,000 L) of waste. Currently the site is filled with gravel and covered to grade with clean fill (WHC 1993a).

3.6.1 Geology

This site is characterized by sandy gravel fill to a depth of 10 ft (3.0 m) bgs. Remnants of a black plastic liner were found at a depth of 10 ft (3.0 m). Below the plastic, from 10 to 18.5 ft (3.0 to 5.6 m) bgs, is quarried, crushed basalt fill ranging from 1 to 4 inches (2.5 to 10 cm) in diameter. Sandy gravel material is present from 18.5 to 24.2 ft (5.6 to 7.4 m) bgs, the total depth of the borehole.

3.6.2 Soil Samples

3.6.2.1 Chemical Analysis. The laboratory analysis results from samples taken from the 116-H-9 vadose zone borehole did not indicate any inorganic levels above the 95 percent UTL. There were no VOC, semivolatile organic, or pesticide contaminants detected. The complete results of the chemical analyses for the samples taken from borehole 116-H-9 are presented in Table A-5, Appendix A.

3.6.2.2 Radionuclide Analysis. Six radionuclides were detected at levels <2 pCi/g (Table 3-11). The detected radionuclides consisted of Cs-137, Eu-152, Ra-226, Th-228, Th-232, and U-238. The complete results of the radionuclide analyses for the samples taken from borehole 116-H-9 are presented in Table A-10, Appendix A.

3.6.2.3 Field Screening. No VOCs were detected above the action level (10 ppm above background) during continuous field screening of borehole 116-H-9, nor was radionuclide activity detected above the background level of 50 CPM.

3.6.2.4 Geophysical Borehole Logging. Logging was performed on the 116-H-9 borehole using a spectral gamma-ray system. No man-made radionuclides (Co-60, Cs-137, Eu-152, and Eu-154) were detected in the borehole.

3.6.3 Conclusions

The 116-H-9 reactor confinement seal pit drainage crib was found to have no levels of inorganic, organic, or pesticide contamination based on review of the LFI data. Radionuclides were detected in small amounts generally at a depth of 17.6 to 20.1 ft bgs. The LFI data are supported by the historical data (Dorian and Richards 1978), which indicate a clean site. Figure 3-5 provides the geologic log and the depth of the LFI samples.

The results of the LFI on the analogous 116-D-9 crib (DOE-RL 1993c) support the non-radionuclide LFI data presented above. The radionuclides detected at the 116-D-9 site were Sr-90, Ra-226, Th-228, U-238, and Am-241 with the maximum concentration being that of Sr-90 at 2.9 pCi/g. The suite of radionuclides detected at the two sites are similar but not an exact match.

3.6.4 Groundwater Assessment

Results from sampling at monitoring well H4-49, located down gradient from the 116-H-9 site, did not indicate any contamination. The 116-H-9 site does not appear to be having an impact to the groundwater.

3.7 NON-INTRUSIVE INVESTIGATION OF OTHER HIGH-PRIORITY SITES

3.7.1 116-H-5 Process Effluent Outfall Structure

The 116-H-5 outfall structure was a compartmented concrete box that overflowed to the Columbia River via a concrete sluiceway. The 116-H-5 structure measures 378 ft long by 27 ft wide by 14 ft deep (115 m long by 8 m wide by 4 m deep) and is located directly to the north of the 116-H-7 retention basin. From 1949 to 1965, the outfall structure received treated process effluent from the 116-H-7 retention basin, directing it to the Columbia River through either dual 60-inch (152-cm) steel discharge pipes or a basalt-covered spillway down the river bank. The spillway was apparently used during periods when pipelines were unable to accommodate the effluent volume (Dorian and Richards 1978). The 116-H-5 outfall structure is now demolished and backfilled with 10 ft (3 m) of soil, except for the spillway. Waste inventories or sample analyses have not been conducted for the 116-H-5 outfall structure.

3.7.1.1 LFI Data and Analogous Sites. No LFI data have been collected for this waste site. The facilities associated with the 116-H-7 process effluent retention basin are proposed for remediation using the LFI results from the retention basin to make the decisions along the IRM path (DOE-RL 1992a). As reported in Section 3.5, the major contaminants found associated with the 116-H-7 retention basin were radionuclides consisting of Co-60, Sr-90, Cs-137, Eu-152, Eu-154, and small amounts of Pu-239/240.

Analogous LFI data were collected from the 116-D-5 outfall structure located in the 100 D area (DOE-RL 1993c). Table 3-12 presents the analytes from this analogous site, which may be considered COPC. The LFI data from the 116-D-5 outfall structure showed no levels of radionuclides above what could be considered typical concentrations. Radium-226 and Th-228 were detected at levels of less than 1 pCi/g and are likely naturally occurring radionuclides in the soil.

3.7.1.2 Historical Data. No other data or historical information has been identified for the 116-H-5 outfall structure.

3.7.1.3 Conclusions. Because there is little information for these process outfall structures, the identification of potential contaminants is limited to information from the analogous 116-D-5 outfall structure. The data from the 116-H-7 process effluent retention basin is not likely to be representative of the 116-H-5 outfall structure site. Further analysis of the 116-H-5 outfall structure may be required in order to make an accurate assessment of the level and type of contamination at the site. Based solely on the analogous 116-D-5 data, little to no contamination would be expected at the 116-H-5 outfall structure.

3.7.1.4 Groundwater Assessment. Data from monitoring well H4-4, located immediately upgradient of the 116-H-5 outfall structure indicates high concentrations of gross alpha (66 pCi/liter) and Tc-99 (793 pCi/liter). The monitoring well data indicate that there is a current impact to the groundwater. However, due to the fact the well is upgradient of the 116-H-5 site, the process effluent pipelines or the 116-H-6 solar evaporation basins (WHC 1988) are more likely to be contributing contaminants.

3.7.2 Process Effluent Pipelines

Process effluent pipelines emanate from the H Reactor building to various process effluent disposal and treatment facilities. Process effluent pipelines also run from the 116-H-7 retention basin to both the Columbia River and the 116-H-1 trench. The lines are approximately 2,000 ft (610 m) long, constructed of steel pipe, and are buried approximately 20 ft (6 m) below the land surface. They are presumably still in place. Portions of this pipeline system lie beneath areas surrounded by security fences.

3.7.2.1 LFI Data and Analogous Sites. No LFI sampling was performed at this site. The facilities associated with the 116-H-7 process effluent retention basin are proposed for remediation using the LFI results from the retention basin to make the decisions along the IRM path (DOE-RL 1992a). As reported in Section 3.5, the major contaminants found associated with the 116-H-7 retention basin were radionuclides consisting of Co-60, Sr-90, Cs-137, Eu-152, Eu-154, and small amounts of Pu-239/240.

One of the process effluent lines located upstream of the 116-H-7 retention basin was investigated in 1991 (WHC 1991d) with a video camera and radiation monitor mounted on a remote-controlled crawler. No discernable breeches of the pipe integrity were observed, and the pipe was found to be sealed with concrete near the 116-H-7 retention basin. Gamma radiation levels were monitored and found to be less than 1 millirem. Smearable

contamination levels were obtained from the crawler and control cable, giving a good indication of the contamination levels of the rust scale in the pipe. These levels averaged 100 to 1,000 CPM. No analogous sites were sampled.

3.7.2.2 Historical Data. Dorian and Richards (1978) indicated that soil contamination from effluent pipeline leakage in the 116-H-7 area appears to be minimal. No measurable contamination was detected with a Geiger-Muller probe in the soil adjacent to the 116-H-7 effluent lines and junction boxes.

Limited radiological sampling was performed on the pipelines by Dorian and Richards (1978). Two sets of historical data are presented in the 100-HR-1 Qualitative Risk Assessment (WHC 1993a): the maximum concentrations of radionuclides in the soil column along the effluent pipelines, and the maximum concentrations of either the sludge from 116-H-7 retention basin or the sludge from inside the pipeline distribution box. These data show high concentrations (up to 26,100 pCi/g of Eu-152 when corrected for decay to 1992) in the sludge and scale samples taken from the effluent pipeline.

3.7.2.3 Conclusions. Both remote monitoring and historical data of the process effluent pipelines indicate elevated levels of radionuclide contamination. The contamination appears to be concentrated in the sludge and scale found on the inside walls of the pipe and at distribution boxes, based on the results of the historical sampling by Dorian and Richards (1978). The integrity of the section of pipeline inspected by remote sensors appeared to be adequate. The integrity of the other sections of pipeline within the 100-HR-1 Source Operable Unit is unknown. There are no known reasons to suspect that the investigated section of pipeline is not representative of the rest of the pipelines in the operable unit.

3.7.2.4 Groundwater Assessment. Because of the great linear extent of the process effluent pipelines across the 100-HR-1 Operable Unit, it is difficult to assess, from the existing monitoring wells, the current impact to groundwater posed by the process effluent pipelines. Because of the large volumes of effluent transported by the pipelines and their history of extensive leakage they are considered to be current sources of groundwater impact.

3.7.3 116-H-7 Sludge Burial Trench

The 116-H-7 (107-H) sludge burial trench is located to the east of the 116-H-7 retention basin, along the Columbia River in the southeast corner of the 100-HR-1 Source Operable Unit. (There are no available data that indicate the dimensions of the trench.) The trench is not enclosed by the H Reactor security fence. Sludge from the 116-H-7 retention basin was removed in 1953 and 1965. The material removed in 1953 was placed in the 116-H-7 sludge burial trench; the sludge removed in 1965 was deposited in the 116-H-1 trench.

3.7.3.1 LFI Data and Analogous Sites. No LFI sampling was performed at this site. The facilities associated with the 116-H-7 process effluent retention basin are proposed for remediation, using the LFI results from the retention basin to make the decisions along the

IRM path (DOE-RL 1992a). As reported in Section 3.5, the major contaminants found associated with the 116-H-7 retention basin were radionuclides consisting of Co-60, Sr-90, Cs-137, Eu-152, Eu-154, and small amounts of Pu-239/240.

The 116-H-1 process effluent burial trench is a similar site, and both trenches received sludge from the 116-H-7 retention basin. However, the 116-H-1 trench is not considered an analogous site, because in addition to sludge from the retention basin, the 116-H-1 site also received process effluent contaminated by fuel-element ruptures.

3.7.3.2 Historical Data. Analysis of a borehole sample taken at a depth of 15 ft (4.6 m) (Dorian and Richards 1978) detected no significant radioactive contamination. Chemical analysis was not performed. Radiological analysis identified very small amounts (less than 0.5 pCi/g) of Sr-90, Eu-154, and Eu-155. Carbon-14, Co-60, Cs-134, Cs-137, Eu-152, Pu-238, and Pu-239/240 were analyzed for but not detected. The 116-H-7 trench was removed from radiological controls in 1965.

No historic data has been found for organic or inorganic contaminants.

3.7.3.3 Conclusions. Based on the historical data presented in Section 3.7.3.2, the LFI data for the 116-H-7 retention basin and the 116-H-1 effluent disposal trench may not be accurate analogous sites to the 116-H-7 sludge burial trench with regard to radionuclide contamination levels. The historical data indicates that the 116-H-7 trench contains only very small amounts of radionuclide contamination. The levels of organic and inorganic contaminants are unknown.

There are no facilities in the 100 Area which have been or are being currently investigated as part of an LFI which are directly analogous to the 116-H-7 sludge burial trench.

3.7.3.4 Groundwater Assessment. As with the 116-H-7 retention basin, monitoring well H4-11, which was constructed and sampled as part of the 100-HR-3 Groundwater Operable Unit LFI (DOE-RL 1993d), is located downgradient from the 116-H-7 sludge burial trench and has elevated gross alpha levels (4.3 pCi/liter), as well as elevated levels of Tc-99 (36 pCi/liter), Sr-90 (26 pCi/liter), and chromium (90 μg/liter) relative to upgradient wells. Monitoring well H4-13, also located downgradient of the 116-H-7 sludge burial trench and south of H4-11, has elevated levels of Sr-90 only (33 pCi/liter). Monitoring well data indicate that there is a current impact to the groundwater though the 116-H-7 retention basin and the process effluent pipelines may also be contributing contaminants.

3.7.4 132-H-3 Effluent Pumping Station

The 132-H-3 effluent pumping station is located in the southwest corner of the 100-HR-1 Source Operable Unit, within the H Reactor building security fence, near the western edge of the H Reactor building. The 132-H-3 effluent pumping station consisted of four sumps containing approximately 80,000 gal (302,880 L) of water. At the time of de-commissioning in 1977, the basins also contained approximately 1,000 gal (3,786 L) of

sludge. This station collected and pumped water from the H Reactor building drains, including the irradiated fuel storage drains, into the process effluent system to the 116-H-7 retention basin. The facility was in service from 1949 to 1965. In 1977 sump water was removed and trucked to the 1325-N liquid waste disposal unit in the 100-N Area. The sludge was packaged in drums and placed in the H Reactor building for storage, and the 132-H-3 effluent pumping station was demolished in situ and backfilled with approximately 15 ft (5 m) of clean fill (WHC 1993a).

3.7.4.1 LFI Data and Analogous Sites. No LFI data for the 132-H-3 effluent pumping station were collected. Data collected from the analogous 132-D-3 effluent pumping station within the 110-DR-1 Source Operable Unit show no organic or inorganic contaminants and only one radionuclide [Ra-226 value of < 1 pCi/g at a depth of 19.8 ft (6.0 m)].

3.7.4.2 Historical Data. Sludge and water samples from four sumps in the 132-H-3 effluent pumping station were analyzed before the pumping station was decommissioned. Radionuclide concentrations from these samples ranged from 3.8 pCi/g for Pu-239/240 to 150 pCi/g for Co-60 and Cs-137. Radionuclides detected included H-3, C-14, Co-60, Sr-90, Cs-137, Eu-152, and Pu-239/240 (Dorian and Richards 1978). Radiological sampling (1977) using a Geiger-Mueller probe measured up to 4,000 CPM of activity along the pipelines and pumps within the pumping house station.

3.7.4.3 Conclusions. The LFI data for the analogous 132-D-3 site and the historical data for the 132-H-3 site vary greatly on the type and concentration levels of radionuclide contamination to be expected in the 132-H-3 pumping station. Since the historical data were taken before the sump was drained and the sludge removed, it is probably not representative of the site's present status. The 132-H-3 site should be addressed as a solid waste burial site.

3.7.4.4 Groundwater Assessment. Due to the location of the 132-H-3 effluent pumping station relative to other closely located sites, it is impossible to accurately assess the impact of any one of these sites on the groundwater. Monitoring wells located near the H Reactor building (adjacent to the 132-H-3 site) do not indicate elevated levels of contamination in the groundwater. Other sites located in the same area are the 116-H-4 pluto crib, the 116-H-9 reactor confinement seal pit drainage crib, the 116-H-2 effluent disposal trench, 132-H-2 exhaust air filter building, and the 132-H-1 reactor exhaust stack.

3.7.5 132-H-2 Exhaust Air Filter Building

The 132-H-2 (117-H) exhaust air filter building was located approximately 80 ft (24 m) southwest of the 118-H reactor building. The 132-H-2 building was a reinforced concrete structure, 59 ft (18 m) long, 39 ft (12 m) wide, and 35 ft (11 m) high, with a typical wall thickness of 15 inches (40 cm). Ninety percent of the structure was below the ground. It was built in 1960 to filter the H Reactor exhaust air before it was routed to the 132-H-1 reactor exhaust stack. The 132-H-2 building was built on the 116-H-4 pluto crib site and was subsequently demolished; the site was leveled and filled with clean soil in 1983.

Contaminated rubble was buried at least 3 ft (1 m) deep, and rubble from the seal pits was buried under a minimum of 15 ft (5 m) of clean soil (WHC 1993a).

3.7.5.1 LFI Data and Analogous Sites. No LFI data have been collected at the 132-H-2 exhaust air filter building, and there are no analogous or process-related sites that have been sampled as part of an LFI. The 116-D-2 exhaust air filter building is an analogous site that was investigated by Beckstrom and Loveland (1986) prior to the initiation of the LFI process.

3.7.5.2 Historical Data. Prior to demolition, radiation surveys and isotopic analyses of concrete and paint were made. The total estimated inventory was 0.41 millicuries of radionuclide activity including isotopes such as H-3, C-14, Co-60, Sr-90, Cs-137, Eu-152, Eu-154, and Pu-239/240 (Powers 1986).

3.7.5.3 Conclusions. Because the site was demolished and buried in situ, it should be treated as a solid waste burial ground. Remediation of the 132-H-2 filter building will be performed during the decontamination and decommissioning of the H Reactor building and facilities (DOE 1989). There are no facilities in the 100 Area currently investigated as part of an LFI which are directly analogous to the 132-H-2 exhaust air filter building.

3.7.5.4 Groundwater Assessment. Due to the location of the 132-H-2 exhaust air filter building relative to other closely located sites, it is impossible to accurately assess the impact of any one of these sites on the groundwater. Monitoring wells located near the H Reactor building (adjacent to the 132-H-2 site) do not indicate elevated levels of contamination in the groundwater. Other sites located in the same area are the 116-H-4 pluto crib, the 116-H-9 reactor confinement seal pit drainage crib, the 116-H-2 effluent disposal trench, 132-H-3 effluent pumping station, and the 132-H-1 reactor exhaust stack.

3.7.6 132-H-1 Reactor Exhaust Stack

The 132-H-1 reactor exhaust stack was a reinforced concrete stack measuring 200 by 16 ft (61 m by 5 m), formerly located directly to the southwest of the H Reactor building. The stack was demolished in 1983. After the demolition of the stack, about one-third of the foundation rubble was buried in a trench located between the demolished 132-H-2 and 132-H-3 buildings. The remainder of the foundation was buried in place and covered with approximately 3 ft (1 m) of clean fill.

3.7.6.1 LFI Data and Analogous Sites. No LFI data for the 132-H-1 reactor exhaust stack have been collected, and there are no analogous sites or process-related sites that have been sampled as part of an LFI.

3.7.6.2 Historical Data. A documented release of radionuclides from the stack occurred in 1955. A ruptured fuel element burned briefly during discharge, resulting in a stack emission.

Prior to demolition of the stack, five concrete core samples were taken from the stack and analyzed for radionuclides (Beckstrom 1987). The analysis detected some levels of H-3, C-14, Co-60, Sr-90, Cs-137, and Eu-152.

3.7.6.3 Conclusions. Radionuclides were detected in the concrete samples taken from the stack when it was demolished. Available data from this site are sufficient to allow it to be addressed as a solid waste burial ground.

3.7.6.4 Groundwater Assessment. Due to the location of the 132-H-1 reactor exhaust stack relative to other closely located sites, it is impossible to accurately assess the impact of any one of these sites on the groundwater. Monitoring wells located near the H Reactor building (adjacent to the 132-H-1 site) do not indicate elevated levels of contamination in the groundwater. Other sites located in the same area are the 116-H-4 pluto crib, the 116-H-9 reactor confinement seal pit drainage crib, the 116-H-2 effluent disposal trench, 132-H-3 effluent pumping station, and the 132-H-2 exhaust air filter building.

3.7.7 116-H-4 Pluto Crib

The 116-H-4 (105-H) pluto crib was located southwest of and adjacent to the 132-H-3 effluent pumping station. The dimensions were 4 by 4 by 2 ft (1.2 by 1.2 by 0.6 m) deep. The 116-H-4 crib received cooling water and discharge contaminated by failed fuel elements, at a flow rate of approximately 2 gal/minute (min) (7.6 L/min) for short periods. This crib was in service from 1950 to 1952. During its period of operation it was covered with 2 ft (0.6 m) of soil (Stenner et al. 1988). The Waste Information Data System (WIDS) (DOE-RL 1991b) reported 10 ft (3 m) of soil had been used to cover the pluto crib. In 1960, the 116-H-4 crib was excavated, and the material was buried in the 118-H-5 burial ground. Also, in 1960, the 132-H-2 (117-H) exhaust air filter building was built on the same location. After it was retired, the building was demolished and buried in situ. The filter building is discussed in Section 3.7.5.

3.7.7.1 LFI Data and Analogous Sites. No LFI data have been collected for this waste site. The 116-H-4 pluto crib was similar to the pluto cribs of the B, D, DR, and F Areas; however, the waste material has been dug up from 116-H-4 and moved to the 118-H-5 burial ground. The site is therefore not considered to be analogous to the other pluto cribs in the 100 Area. Material from the demolition of the 132-H-2 filter building is buried in place.

3.7.7.2 Historical Data. Approximately 2,200 lb (1,000 kg) of sodium dichromate were disposed of in the 116-H-4 crib. There is no radionuclide inventory of the exhumed 116-H-4 crib material.

3.7.7.3 Conclusions. The limited remains of 116-H-4 pluto crib and the 132-H-2 exhaust air filter building are viewed as a single site. The data are sufficient to indicate that the site should be addressed as a solid waste burial ground. Remediation of the site will be performed during the decontamination and decommissioning of the H Reactor building and facilities (DOE 1989). Materials from the 116-H-4 crib will likely be remediated in

conjunction with any activity undertaken at the 118-H-5 burial ground (100-HR-2 Source Operable Unit).

3.7.6.4 Groundwater Assessment. Due to the location of the 116-H-4 pluto crib relative to other closely located sites, it is impossible to accurately assess the impact of any one of these sites on the groundwater. Monitoring wells located near the H Reactor building (adjacent to the 116-H-4 site) do not indicate elevated levels of contamination in the groundwater. Other sites located in the same area are the 116-H-9 reactor confinement seal pit drainage crib, the 116-H-2 effluent disposal trench, 132-H-3 effluent pumping station, the 132-H-2 exhaust air filter building, and the 132-H-1 reactor exhaust stack,.

3.8 LOW-PRIORITY SITES INVESTIGATED DURING LFI

3.8.1 1607-H-2 Septic Tank

The 1607-H-2 septic tank served the 182-H, 183-H, 190-H, and several 1700-H office and maintenance service buildings. The system, now inactive, had a 500 person capacity and three manholes available for entry. The tank is located in the northwest section of the 100-HR-1 Source Operable Unit (Figure 2-1) (DOE-RL 1992a).

3.8.1.1 Chemical Analysis of Samples. The chemical analysis of the two sludge samples and five water samples taken from the 1607-H-2 septic tank system indicated high concentrations of heavy metal and sulfate contamination (Table 3-13). The detected contaminants were predominantly confined to the sludge samples. With the exception of a small amount of methylene chloride (300 μg/liter) detected in one water sample (Table 3-14), no VOCs were found in any of the samples. The heavy metal contaminants found included barium, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc; all in levels 20 to 100 times the 95 percent UTL (Table 3-13). Arsenic and thallium were also detected above the 95 percent UTL. Sulfate levels were detected at approximately five times the 95 percent UTL. Table B-1 of Appendix B presents the complete chemical analysis data for the 1607-H-2 septic tank samples.

3.8.1.2 Radionuclide Analysis of Samples. The radionuclide analysis of the 1607-H-2 samples showed high concentrations of many of the radionuclides analyzed. However, it should be noted that the data validation report for this analysis indicated calibration errors in the analysis equipment, prompting rejection of most of the radionuclide data. Of the radionuclide data which was not rejected, concentrations of six radionuclides, at levels <2.1 pCi/g, were detected. Table 3-15 presents these six radionuclides detected in the sludge samples and Table B-2 of Appendix B presents the complete radionuclide analysis results.

3.8.1.3 Conclusions. The predominant non-radionuclide contaminants detected in the 1607-H-2 septic tank samples were heavy metals and sulfate in the sludge. The source of the heavy metal contamination is unclear but may be from chemicals poured down the sanitary sewer system or may simply be from the concentration of human sewage. The radionuclide contaminants detected were Co-60, Cs-137, Eu-152, Ra-226, Th-228, and Th-232. Further

or reanalysis of water and sludge samples may be necessary to adequately determine the true extent, if any, of radionuclide contamination in the 1607-H-2 septic tank.

3.8.2 1607-H-4 Septic Tank

The 1607-H-4 septic tank received sanitary sewage from the 181-H river pumphouse. The system, now inactive, had a six-person capacity and a removable concrete cover. The tank is located south of the river and north of the 1607-H-2 site (Figure 2-1) (DOE-RL 1992a).

3.8.2.1 Chemical Analysis of Samples. The chemical analysis of the soil samples taken from the test pit at the 1607-H-4 septic tank indicates no contamination of the soil in the leach field. However, a sample taken from inside the septic tank discharge pipe (sample number B07211) did indicate contamination. This contamination consisted of several heavy metals (barium, copper, lead, and zinc) at levels above the 95 percent UTL and semivolatile PNA compounds (Tables 3-16, 3-17, and 3-18). The PNAs were detected in concentrations of less than 3 mg/kg. Pesticides 4,4-DDD, 4,4-DDE, and gamma-chlordane were detected at levels of less than 1 mg/kg in the sample taken from the discharge pipe (Table 3-19). As discussed earlier, PNAs may be associated with coal tars or creosote (Ekambaram et al. 1988). Table B-3, Appendix B, presents the complete chemical analysis data for 1607-H-4 soil samples.

3.8.2.2 Radionuclide Analysis of Samples. The soil samples taken from the test pit and from the septic tank discharge pipe contained small amounts of Cs-137, Eu-152, Ra-226, Th-228, Th-232, U-233/234, and U-238 in concentrations $\leq$ 1.2 pCi/g (Table 3-20). Table B-4, Appendix B, presents the complete radionuclide analysis results for the samples taken from the 1607-H-4 septic tank excavation.

3.8.2.3 Conclusions. Heavy metals, small amounts of PNAs, and radionuclide contamination were found in a sample taken from the discharge pipe of the 1607-H-4 septic tank. No contaminants were detected in the soil samples taken from the test pit in the septic tank leach field. This suggests that there may be isolated areas of concentrated contaminants within the septic tank itself (which is backfilled) and in and immediately around the discharge piping, but that there is little contamination within the leach field soil itself.

3.8.3 Electrical Facilities

Several abandoned electrical facilities exist within the 100-HR-1 Source Operable Unit. Electrical equipment, including transformers containing PCBs, were used at some of these sites. The sampling locations are shown in Figure 2-1 (DOE-RL 1992a).

3.8.3.1 PCB Analysis of Samples. Surface soil samples were taken from the electrical facilities where PCB contamination was suspected (i.e., visible spills and areas where equipment containing PCBs was used) and analyzed for PCB contamination. PCBs were detected in five of the eight samples analyzed in levels ranging from 32 to 1,200 μj/kg

(Table 3-21). Aroclor-1254 was detected in two of the samples taken from the 151-H facility area, and Aroclor-1260 was detected in two samples taken from the 151-H facility area and also in a sample taken from outside the 105-H building (Figure 2-1). Table B-5 in Appendix B provides the complete laboratory data results for the eight samples taken.

3.8.3.2 Conclusions. PCBs were detected in surface soil samples collected around abandoned electrical facilities in the 100-HR-1 Source Operable Unit. The physical extent of the contamination is not presently known but could likely be determined by visual inspection of the sample sites.

3.8.4 Support Facilities

The 100-HR-1 radiological survey field task consisted of two activities: characterization of the operable unit-specific background conditions and the radiological survey of the operable unit surface area. The purpose of the radiological survey was to measure gross gamma radiation levels of the surface soil.

The total surface area surveyed was approximately 105 acres. Within this area, a total of 126,425 data points were collected. Each of these data points represent a gross gamma radiation reading, along with the physical coordinates of the reading location. A total of 127 individual surveys were conducted in order to complete the 105 acres of surface area. Sections of the operable unit not surveyed include the area inside the 116-H-7 exclusion fence, the 116-H-6 solar basin, and the river shore.

During the period of time when the 100-HR-1 radiation survey was conducted, the Columbia River was relatively high; therefore, the portion of the 100-HR-1 Source Operable Unit below the riverbank crest could not be effectively surveyed.

Of the 127 surveys conducted at the 100-HR-1 site, 22 surveys recorded elevated readings. However, in only 10 of the 22 surveys could the elevated readings be verified and duplicated. The elevated readings in the remaining 12 surveys are interpreted to have been caused by noise spikes introduced by loose or faulty cables connecting the gamma detector to the digital rate meter. Any faulty cables were repaired or replaced. Figure 3-6 shows the ten locations where contamination was detected. Details on the radiological survey and the complete results are found in *100-HR-1 Radiological Surveys* (Beckstrom and Wade 1991).

3.9 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Section 121(d) of CERCLA, as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), requires that fund-financed, enforcement, and federal facility remedial actions comply with ARARs of federal environmental laws and more stringent, promulgated state environmental or facility siting laws.

Comprehensive Environmental Response Compensation and Liability Act defines applicable requirements as those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under

federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site.

In addition to ARARs, CERCLA also provides for the consideration of to-be-considered (TBC) guidance, non-promulgated advisories or guidance documents issued by federal or state governments that do not have the status of potential ARARs but which may be considered in determining necessary levels of protection of health or the environment.

Applicable or relevant and appropriate requirements may be further subdivided into the following categories:

- *Chemical-specific requirements* - health- or risk-based numerical values or methodologies that, when applied to site-specific conditions, result in the establishment of numerical values. If a chemical has more than one such requirement that is an ARAR, compliance should generally be with the most stringent requirement.

- *Location-specific requirements* - restrictions placed on the concentration of hazardous substances or the conduct of activities solely because they are in specific locations, such as wetlands or historic places.

- *Action-specific requirements* - technology- or activity-based requirements or limitations on actions taken with respect to hazardous wastes. These requirements are triggered by the particular remedial activities that are selected to accomplish a remedy.

Potential chemical- and location-specific ARARs are defined during the field investigation portion of the CERCLA process and refined in the feasibility study and proposed plan. Action-specific ARARs are generally defined during the phase I and II feasibility study and refined in detailed analysis and the proposed plan. Potential ARARs and TBCs in all categories are defined in the *100 Area Feasibility Study Phases 1 and 2* (DOE-RL 1992c). For purposes of this LFI, only the chemical- and location-specific ARARs are discussed. The ARARs are presented in Tables 3-22 through 3-27.

Chemical-specific ARARs for soils are limited to those levels for hazardous constituents prescribed in the state's MTCA. Currently, MTCA has not defined levels for radionuclides. Additional soil limits are presented in Subpart S of RCRA for hazardous constituents and in DOE Order 5400.5 for radionuclides. These are considered TBCs for the 100 Area operable units. Potential chemical-specific ARARs for air emissions are also identified for the 100 Area; however, these tend to also be based on specific actions which have a tendency to increase releases to the air. Therefore, these are more appropriately

addressed in the focused feasibility study. Potential chemical-specific ARARs are listed in Table 3-22 and 3-23; TBCs are included in Table 3-24.

Potential location-specific ARARs are identified for the 100 Area because of the presence of threatened or endangered species and archaeological resources. In addition, potential location-specific ARARs based on possible impacts to wetlands and floodplains are included. These are described in Tables 3-25 and 3-26; TBCs are in Table 3-27.

This discussion of potential ARARs is intended to be a refinement of ARARs presented in the work plan. Additional evaluation of potential ARARs will be done in the FS phase. Final ARARs will be determined in the ROD.